

OHIO RIVER BASIN
BIGBY CREEK, SOMERSET COUNTY

PENNSYLVANIA

BIGBY RUN DAM

NDI ID NO. PA-226

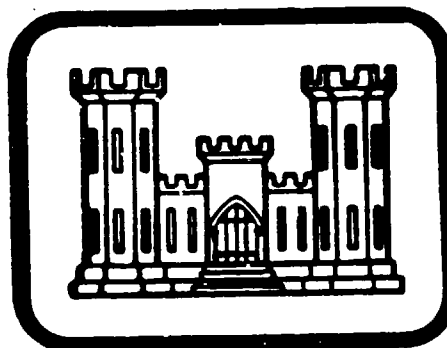
DER ID NO. 56-21

LEVEL II

AD A108951

~~GARRETT MUNICIPAL WATER AUTHORITY~~

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



12 77

DTIC FILE COPY

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

DTIC
ELECTE
DEC 29 1981
S D

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

*Original contains color
plates: All DTIC reproduct-
ions will be in black and
white*

JUNE, 1981

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

411059

81 12 28 204

OHIO RIVER BASIN
BIGBY CREEK, SOMERSET COUNTY

PENNSYLVANIA

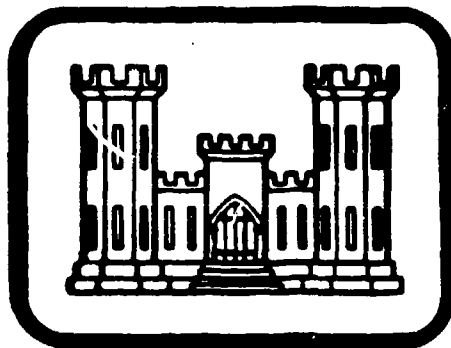
BIGBY RUN DAM

NDI ID NO. PA-226

DER ID NO. 56-21

GARRETT MUNICIPAL WATER AUTHORITY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
by <i>Re DTIC Form 50</i>	
Distribution/ <i>on file</i>	
Availability Codes	
Dist	Avail and/or Special
<i>A</i>	

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

Contract DACW31-81-C-0012

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

**DTIC
ELECTE
DEC 29 1981**

*Original contains color
plates: All DTIC reproduct-
ions will be in black and
white*

JUNE, 1981

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Bigby Run Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Somerset
STREAM	Bigby Run
DATES OF INSPECTION	November 6, 1980 and May 12, 1981
COORDINATES	Lat: 39° 51.6' Long: 79° 4.5'

ASSESSMENT

The assessment of Bigby Run Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

The Bigby Run Dam appears to be in fair condition. Maintenance is considered fair. The concrete spillway is deteriorating with marked deterioration on the right spillway wall. Minor seepage was observed at the toe of the dam, adjacent to the left abutment contact. Seepage was estimated at 2 to 5 gallons per minute. The seepage should be monitored.

The Bigby Run Dam is a high hazard-small size dam. The recommended Spillway Design Flood (SDF), for a dam of this size and classification, is in the range of 1/2 PMF to PMF. Since the Bigby Run Dam just meets the minimum criteria; and since the dam is located in a rural area suggesting only appreciable economic loss; compliance with the current practice of the Baltimore District Corps of Engineers leads to the selection of the 1/2 PMF as the Spillway Design Flood (SDF). The spillway and reservoir are capable of controlling approximately 25% of the PMF, without overtopping the embankment. Based on criteria established by the Corps of Engineers, the spillway is termed inadequate, but not seriously inadequate.

The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to design modifications to increase the spillway capacity.
2. The observed seepage at the downstream toe of the dam, adjacent to the left abutment contact, should be monitored. Seepage moni-

BIGBY RUN DAM
PA 226

toring data should be evaluated by a registered professional engineer knowledgeable in dam design and analysis and control measures implemented as recommended.

3. The concrete in the spillway should be repaired.
4. An operation and maintenance schedule should be prepared and implemented to insure the continued safe operation of the structure.
5. The remaining trees on the upstream slope of the dam should be removed under the direction of a registered professional engineer knowledgeable in dam design and analysis.
6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.
7. Positive drainage should be provided at the outlet for the 18" cast iron pipe drainline.
8. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

JUNE 15, 1981
Date

R. Jeffrey Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

7 July 81
Date

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
Commander and District Engineer



Overview of Bigby Run Dam

TABLE OF CONTENTS

	PAGE
SECTION 1 - PROJECT INFORMATION	1
1.1 General	1
1.2 Description of Project	1
1.3 Pertinent Data	2
SECTION 2 - ENGINEERING DATA	5
2.1 Design	5
2.2 Construction	5
2.3 Operation	5
2.4 Evaluation	5
SECTION 3 - VISUAL INSPECTION	6
3.1 Findings	6
3.2 Evaluation	7
SECTION 4 - OPERATIONAL PROCEDURES	8
4.1 Procedures	8
4.2 Maintenance of Dam	8
4.3 Maintenance of Operating Facilities	8
4.4 Warning System in Effect	8
4.5 Evaluation	6
SECTION 5 - HYDRAULICS AND HYDROLOGY	9
5.1 Evaluation of Features	9
5.2 Evaluation Assumptions	9
5.3 Summary of Overtopping analysis	9
5.4 Summary of Dam Breach Analysis	10
SECTION 6 - STRUCTURAL STABILITY	11
6.1 Evaluation of Structural Stability	11
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES	13
7.1 Dam Assessment	13
7.2 Recommendations/Remedial Measures	13

APPENDICES

- APPENDIX A - CHECKLIST, VISUAL INSPECTION, PHASE I
- APPENDIX B - CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION,
OPERATION, PHASE I
- APPENDIX C - PHOTOGRAPHS
- APPENDIX D - HYDROLOGY AND HYDRAULICS
- APPENDIX E - DRAWINGS
- APPENDIX F - GEOLOGY

PHASE I
NATIONAL DAM INSPECTION PROGRAM

BIGBY RUN DAM
NDI. I.D. NO. PA 226
DER I.D. NO. 56-21

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. The Bigby Run Dam is an earthfill dam, 280 feet long and 25 feet high. The crest width of the dam is 14 feet. The upstream slope is paved with riprap, but the majority of the riprap and crest of the dam is covered over with grass. A valve house is located on the upstream slope of the dam. Controls for the 18" drainline and 10" supply line are housed in the structure. The valve house is located approximately mid-way across the embankment.

The spillway for the dam consists of a concrete ogee section, 76 feet long. Concrete retaining walls are located at either end of the ogee section. The spillway discharge channel is cut into natural rock, and discharges beyond the toe of the embankment section.

b. Location. The dam is located on Bigby Run, approximately 1 mile southwest of the Borough of Garrett in Somerset County, Pennsylvania. The Bigby Run Dam can be located on the Meyersdale, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. The Bigby Run Dam is a small size dam (25 feet high, 43 acre-feet).

d. Hazard Classification. The Bigby Run Dam is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail. Several homes are located approximately 2,000 feet downstream of the dam, with one home being approximately 1,500 feet downstream of the dam and located approximately on the 2010 contour. The Borough of Garrett is located 1 mile downstream of the dam and several homes are located along the stream which were considered as being damaged and possible loss of life exists if a dam failure were to occur.

e. Ownership. The Bigby Run Dam is owned by Garrett Municipal Water Authority. Correspondence should be addressed to:

Garrett Municipal Water Authority
Box 141
Garrett, Pennsylvania 15542
Attention: Mr. Derbin Lohr
814/634-8749

f. Purpose of Dam. The dam is utilized by the Borough of Garrett as an alternate water supply.

g. Design and Construction History. An application for a permit to construct a dam across Bigby Run was made in July, 1930. The proposed purpose of the dam was to create a water storage reservoir for the use of the town of Garrett and as a water supply for locomotives of the B & O Railroad. The proposed structure was to replace a previous structure at the same location. The initial structure was ordered to be breached in June 1917. No information was available relative to the date the original structure was abandoned. A July 7, 1928 memorandum in the DER file contains information relative to an inspection at the structure. The memorandum states that a 12 foot breach existed in the structure at that time. The memorandum further stated that no further examination of the dam was necessary.

The dam was designed by Gray and Claflin, Consulting Civil Engineers, of Johnstown, Pennsylvania. The construction of the dam began in mid-1930, and approval was given to begin impounding water in early 1931. Only minor work was required to complete the dam at the time permission was given to impound water. No information was available as to who constructed the dam. No information is available as to the reference datum used in the design drawings included in the Appendix of this report.

h. Normal Operating Procedures. The reservoir is not currently used for water supply. Based on an interview with Mr. Derbin Lohr, representing the Garrett Municipal Authority, the quality of water is below standards, and water is presently supplied to the borough from an alternate source. No operations are presently conducted at the dam. During periods of previous operation, water was drawn from the reservoir through a 10" supply line, which feeds the Borough of Garrett.

1.3 Pertinent Data.

a. Drainage Area. 3.6 square miles

b. Discharge at Dam Site (cfs).

Maximum flood at dam site (Hurricane Hazel)	Discharge unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	2610

c. Elevation (M.S.L.) (feet). - Field survey based on an assumed spillway crest elevation, 2130.0 feet, U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	2134.5
Top of dam - design height	2134.0
Pool at time of inspection - November 6, 1980	2130.0
- May 12, 1981	2120.0
Spillway crest	2130.0
Maximum pool - design surcharge	2134.0
Upstream portal - 18" cast iron pipe	Unknown
Downstream portal - 18" cast iron pipe	2109.2
Streambed at centerline of dam	Unknown
Maximum tailwater	Unknown
Toe of dam	2109.2

d. Reservoir (feet).

Length of maximum pool	1000
Length of normal pool	800

e. Storage (acre-feet).

Spillway crest	25
Top of dam	43

f. Reservoir Surface (acres).

Top of dam	4.6
Normal pool	3.7
Spillway crest	3.7

g. Dam.

Type	Earthfill
Length (including spillway)	280 feet
Height	25 feet
Top width	14 feet
Side slopes - upstream	2.5H:1V
- downstream	2H:1V
Zoning	Yes
Impervious core	Concrete corewall
Cutoff	Yes
Grout curtain	Unknown

h. Reservoir Drain.

Type
Length
Closure

Access

Regulating facilities

18" cast iron pipe
Approximately 142'
Gate valve upstream
of concrete corewall
Valve stem
at gate house
on upstream slope
Gate valve

i. Spillway.

Type

Length
Crest elevation
Upstream channel

Downstream channel

Concrete ogee
section
76 feet
2130.0
Lake
(unrestricted)
Bigby Run

SECTION 2 ENGINEERING DATA

2.1 Design. Review of available information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources, revealed that some correspondence, permit information, pictures, and design drawings were available for review. Available design drawings are located in Appendix E of this report. Mr. Derbin Lohr, representing the Garrett Municipal Water Authority, accompanied the inspection team during the inspection, but was unable to supply any additional data.

2.2 Construction. No information exists regarding the construction of the dam.

2.3 Operation. No operating records are known to exist.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterway Management.

b. Adequacy. This Phase I Report is based on the visual inspection and hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I Report.

SECTION 3 VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Bigby Run Dam was conducted by personnel of L. Robert Kimball and Associates on November 6, 1980 and May 12, 1981. During the November 6, 1980 inspection, the inspection team was accompanied by Mr. Chuck Woodward, representing the Department of Environmental Resources, Carnegie Regional Office, and Mr. Derbin Lohr, representing the Garrett Municipal Authority. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appeared to be in fair condition and adequately maintained. Based on a brief survey the crest of the dam is relatively consistent across the entire length of the earthen embankment section. No significant low spots were noted on the crest of the dam.

The upstream slope and crest of the dam were grass covered. A rock fill existed on the entire downstream slope of the dam. It was observed that design drawings did not indicate the existence of rock on the entire slope. Seepage was observed at the toe of the dam near the left abutment contact. Seepage was estimated at 2 to 5 gallons per minute. No other seepage was noted during the inspection.

A second inspection of the dam and appurtenant structures was completed on May 12, 1981. The reservoir pool at the time of the May 12, 1981 inspection was estimated at 2120.0, ten feet below the previous inspection. The drainline was open and attempts were underway to drain the reservoir. It was reported by Mr. Derbin Lohr that the drawdown was required to improve water quality in the reservoir. The brush on the downstream slope was cut since the November 6, 1981 inspection. Two trees still exists on the upstream slope of the dam.

c. Appurtenant Structures. The spillway was observed to be a concrete ogee section. Field measurements taken during the inspection indicated that the length of the crest was approximately 76 feet. In general, the concrete in the spillway was in a deteriorating condition. Deterioration of the concrete was observed on the right spillway retaining wall. The discharge channel for the spillway consisted of an open cut channel in bedrock. No major deficiencies were observed in the area of the spillway which were considered capable of significantly affecting the discharge potential of the structure. A valve house was observed on the upstream slope of the dam.

d. Reservoir Area. The watershed is covered almost equally with forested lands and open fields. Some strip mining is occurring within the watershed, south of the reservoir. The reservoir slopes are moderate to steep, but do not appear to be susceptible to massive landslides, which would affect the storage volume of the reservoir or cause overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel for the Bigby Run Dam consists of Bigby Run. The channel is relatively narrow until it reaches the Borough of Garrett, at which point Bigby Run drains into the Casselman River. Several homes are located approximately 2,000 feet downstream of the dam, with one home being approximately 1,500 feet downstream of the dam and located approximately on the 2010 contour. The Borough of Garrett is located 1 mile downstream of the dam and several homes are located along the stream which were considered as being damaged and possible loss of life exists if a dam failure were to occur.

3.2 Evaluation. In general, the dam and appurtenant structures appear to be in fair condition. No major erosion areas were observed during the inspection. One seepage area was observed at the downstream toe of the dam, and seepage was estimated at 2 to 5 gallons per minute. The concrete in the spillway is in a deteriorating condition. Marked deterioration of the right spillway wingwall was observed.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is presently in the process of being drained in order to improve the water quality in the reservoir.

4.2 Maintenance of the Dam. No planned maintenance schedule exists for the dam. Maintenance of the dam is performed on an unscheduled, as-needed basis.

4.3 Maintenance of Operating Facilities. No planned maintenance exists. Maintenance of the facilities consists of unscheduled, as-needed maintenance of present facilities.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities is considered fair. The concrete in the spillway is in a deteriorating condition. Marked deterioration was observed at the right spillway wingwall. The concrete should be repaired. Minor seepage was observed at the toe of the dam adjacent to the left abutment contact.

An emergency action plan should be available for every dam in the high and significant category. Such plans should outline actions to be taken by the operator to minimize downstream effects of an emergency, and should include an effective warning system. No emergency action plan has been developed.

SECTION 5 HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No information was available relative to the hydrologic and hydraulic design of the dam.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in fair condition. No obstructions were observed in the spillway approach or in the spillway discharge channel that would affect the discharge potential of the spillway. It was noted that during the inspection that the embankment crest was fairly consistent across the entire length.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable completion of the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. The pool elevation in the reservoir prior to the storm was assumed to be at the spillway crest elevation, 2130.0.

2. The top of dam was considered to be at elevation, 2134.5.

3. No discharge was considered through the 18" cast iron pipe or the 10" service line.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	10380 cfs
Peak inflow (1/2 PMF)	5190 cfs
Spillway capacity	2610 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) is based on the hazard and size classification of the dam. The recommended spillway design flood for a dam of this size and hazard classification is in the range of 1/2 PMF to PMF.

No definitive criteria exists to assist the evaluating engineer in selecting a SDF within the given range. The current practice adopted by the Baltimore District Corp of Engineers relates the selection of a Spillway Design Flood to the size and storage potential of the dam.

The Baltimore District Corps of Engineers has determined that the SDF be selected as the lesser value (1/2 PMF) of the 1/2 PMF range for high hazard dams which barely meet the minimum storage or height criteria (size classification), and which are located in rural areas.

Since Bigby Run Dam just meets the minimum size criteria; and since the dam is located in a rural area suggesting only appreciable economic loss; compliance with current practice of the Baltimore District Corps of Engineers leads to the selection of the 1/2 PMF as the Spillway Design Flood (SDF).

Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

Inadequate - All high hazard dams which do not pass the spillway design flood (1/2 PMF).

The spillway and reservoir are capable of controlling approximately 25% of the PMF without overtopping the embankment.

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analysis), it was necessary to perform a dam breach analysis and downstream routing of the flood wave. This analysis determined the degree of increased flooding due to dam failure. A pool elevation of 2135.5, representing 1 foot of overtopping, was considered sufficient to cause failure of the dam due to overtopping.

The results of the dam breach analysis indicate that the downstream potential for loss of life and property damage is not significantly increased by dam failure from that which would exist just prior to failure. Therefore, the spillway is rated as inadequate, but not seriously inadequate. Details of the downstream routing of the flood wave are included in Appendix D.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No erosion was observed during the inspection. A seepage area was observed at the left abutment contact, at the toe of the dam. Seepage in this area was estimated at 2 to 5 gallons per minute. No other seepage was observed during the inspection. No movement or misalignment of the dam was observed during the inspection.

It was noted during the second inspection, May 12, 1981, that the seepage was not significantly reduced due to the reduced level of the reservoir. The seepage appeared to be equal to that observed during the November 6, 1980 inspection.

The spillway was in a visibly deteriorating condition. Deterioration was observed in the right spillway wingwall. During the May 12, 1981 inspection, the reduced level of the reservoir allowed a closer inspection of the ogee section. Soil was observed along the upstream face of the ogee section. This condition was not observed during the November 6, 1980 inspection due to discharges over the spillway at the time. It is possible that some of the material represents fill placed against the upstream face of the dam during construction of the dam. The fill material and silt slopes gently from the spillway crest to the reservoir at a slope of approximately 4H:1V.

b. Design and Construction Data. Construction of the dam began sometime around 1930. The design of the dam was completed by the Gray and Clafin, Consulting Engineers, Johnstown, Pennsylvania. A diagram of spillway thrusts exists in Appendix E, on page E-3. Apparently, a stability analysis of the spillway was completed, but no information was available in the DER files for review. The dam was constructed with a concrete core wall and cutoff, 18" thick at the base and 9" thick at the top. Pipe collars were to be encased in concrete at the joints and portions along the upstream end of the pipe were supported by concrete piers. No information was available relative to construction of the dam.

c. Operating Records. No operating records are known to exist for this dam.

d. Post Construction Changes. No post construction changes are known to have been completed.

e. Evaluation. No major deficiencies were observed during the inspection which were considered as having an immediate effect upon the static stability of the structure. Therefore, the Bigby Run Dam is considered to be statically stable at the present time.

f. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses have been performed. Normally, if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam and appurtenant structures appear to be in fair condition and maintenance is considered fair. No major erosion areas were observed during the inspection. A minor seepage area was observed at the toe of the downstream slope, adjacent to the left abutment contact. Seepage was estimated at approximately 2 to 5 gallons per minute. It was observed during the inspection that the top of dam was relatively consistent across the entire length of the crest. The concrete in the spillway was observed to be in a deteriorating condition, with marked deterioration of the right spillway wall. The majority of the deterioration was observed at the bottom of the retaining wall.

The Bigby Run Dam is a high hazard-small size dam. The recommended Spillway Design Flood (SDF), for a dam of this size and classification, is in the range of 1/2 PMF to PMF. Since the Bigby Run Dam just meets the minimum size criteria; and since the dam is located in a rural area suggesting only appreciable economic loss; compliance with current practice of the Baltimore District Corps of Engineers leads to the selection of the 1/2 PMF as the Spillway Design Flood (SDF).

The visual observations, review of available data, hydrologic and hydraulic calculations, and past operational performance, indicate that the Bigby Run Dam is capable of controlling approximately 25% of the PMF. The spillway is termed inadequate, but not seriously inadequate.

b. Adequacy of Information. Sufficient information is available to complete a Phase I report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to design modifications to increase the spillway capacity.

2. The observed seepage at the downstream toe of the dam, adjacent to the left abutment contact, should be monitored. Seepage moni-

toring data should be evaluated by a registered professional engineer knowledgeable in dam design and analysis and control measures implemented as recommended.

3. The concrete in the spillway should be repaired.
4. An operation and maintenance schedule should be prepared and implemented to insure the continued safe operation of the structure.
5. The remaining trees on the upstream slope of the dam should be removed under the direction of a registered professional engineer knowledgeable in dam design and analysis.
6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.
7. Positive drainage should be provided at the outlet for the 18" cast iron pipe drainline.
8. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Bigby Run Dam COUNTY Somerset STATE Pennsylvania ID# PA 226

TYPE OF DAM Earthfill November 6, 1980 Overcast and cold HAZARD CATEGORY High 35°

DATE(s) INSPECTION May 12, 1981 Clear and cool TEMPERATURE 50-55°

POOL ELEVATION AT TIME OF INSPECTION 2130 Approx. 2120 M.S.L. TAILWATER AT TIME OF INSPECTION 2121.9 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

Mr. Chuck Woodward - Department of Environmental Resources, Carnegie-Regional Office
Bureau of Dams and Waterway Management

Mr. Derbin Lohr - Representing the Garrett Water Authority

O.T. McConnell RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ADJUTANT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	appeared to be all right.	
RIPRAP FAILURES	None noted.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Brush and trees existed on the downstream slope of the dam during the November 6, 1980 inspection.	The brush and trees had been cut as observed during the May 12, 1981 inspection. Remaining trees on upstream should be removed.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appear to be all right.	
ANY NOTICEABLE SEEPAGE	Minor seepage observed at the downstream toe of the dam.	Seepage estimated to be 2 to 5 gallons per minute. Recommend monitoring seepage.
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Brush and trees existed on the downstream slope of the dam during the November 6, 1980 inspection.	The brush and trees had been cut as observed during the May 12, 1981 inspection.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appear to be all right.	
ANY NOTICEABLE SEEPAGE	Minor seepage observed at the downstream toe of the dam.	Seepage estimated to be 2 to 5 gallons per minute. Recommend monitoring seepage.
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable.	
INTAKE STRUCTURE	Not observed.	
OUTLET STRUCTURE	Not observed.	
OUTLET CHANNEL	Not applicable.	
EMERGENCY GATE	Valves on upstream slope in gate house. Controls in gate house for 10" service line and 18" cast iron pipe.	

UNCATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete ogee section appears to be in fair condition. Deterioration of the concrete in the spillway is occurring. Marked deterioration of the right spillway wall was observed.	The concrete should be repaired.
APPROACH CHANNEL	Lake [unrestricted].	
DISCHARGE CHANNEL	Open cut channel on bedrock.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel for the Bigby Run Dam consists of the Bigby Run.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	One home is located approximately 1500 feet downstream of the dam, and the Borough of Garrett is located approximately 1 mile downstream of the dam. The population of the Borough of Garrett is estimated at 500 people.	

RESERVOIR

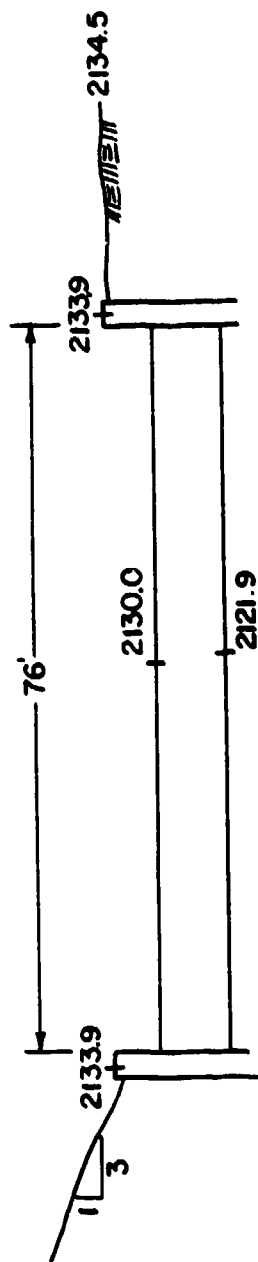
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate to steep, but appear to be stable.	
SEDIMENTATION	Sedimentation is unknown even though the water level was reduced during the May 12, 1981 inspection.	

INSTRUMENTATION

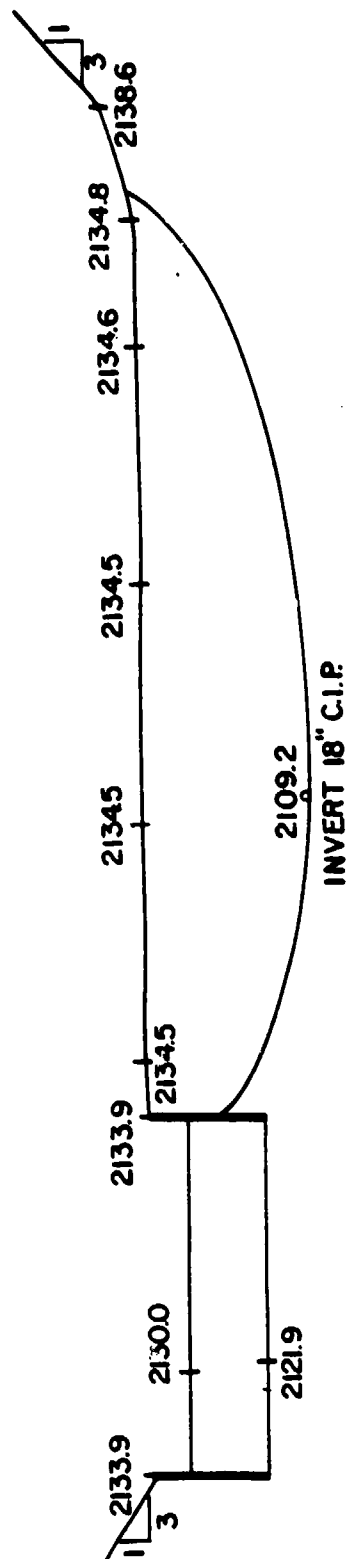
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	



A-12



**SPILLWAY PROFILE
LOOKING UPSTREAM
SCALE: 1"=20'**



**PROFILE
LOOKING UPSTREAM
SCALE: HORIZ. 1"=40'
VERT. 1"=20'**



BIGBY RUN DAM

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Highy Run Dam
 ID# PA 226

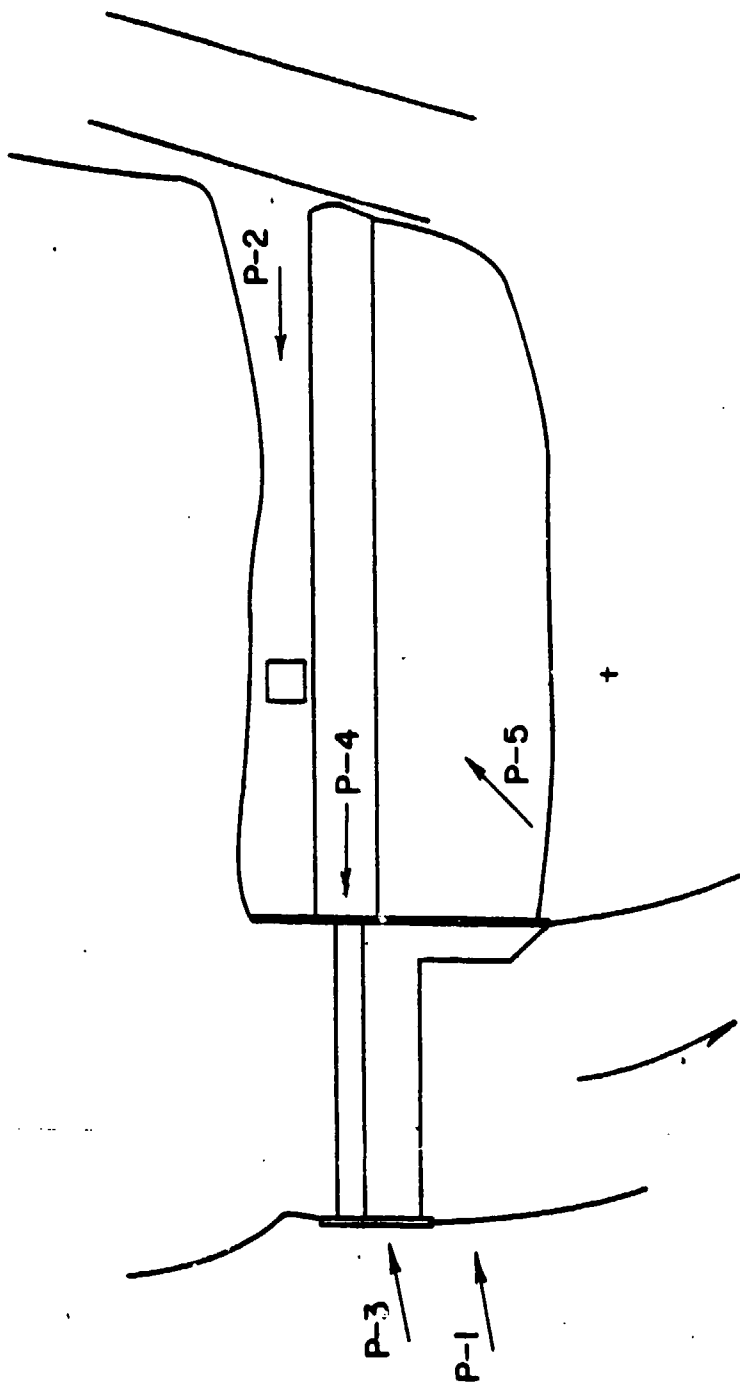
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	Limited information available in DER files.
TYPICAL SECTIONS OF DAM	See Appendix E.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	See Appendix E. See Appendix E. See Appendix E. None. None.

ITEM	REMARKS
DESIGN REPORTS	Unknown.
GEOLOGY REPORTS	Unknown.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Unknown.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown. Some data available in Appendix E on page E-2.
POST-CONSTRUCTION SURVEYS OF DAM	None known to have occurred.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None known to have occurred.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None known to exist.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None known to have occurred.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See Appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	See Appendix E.

APPENDIX C
PHOTOGRAPHS



C-1



BIGBY RUN DAM PHOTO INDEX

P-INDICATES PHOTO LOCATION

BIGBY RUN DAM
PA 226

Sheet 1

Front

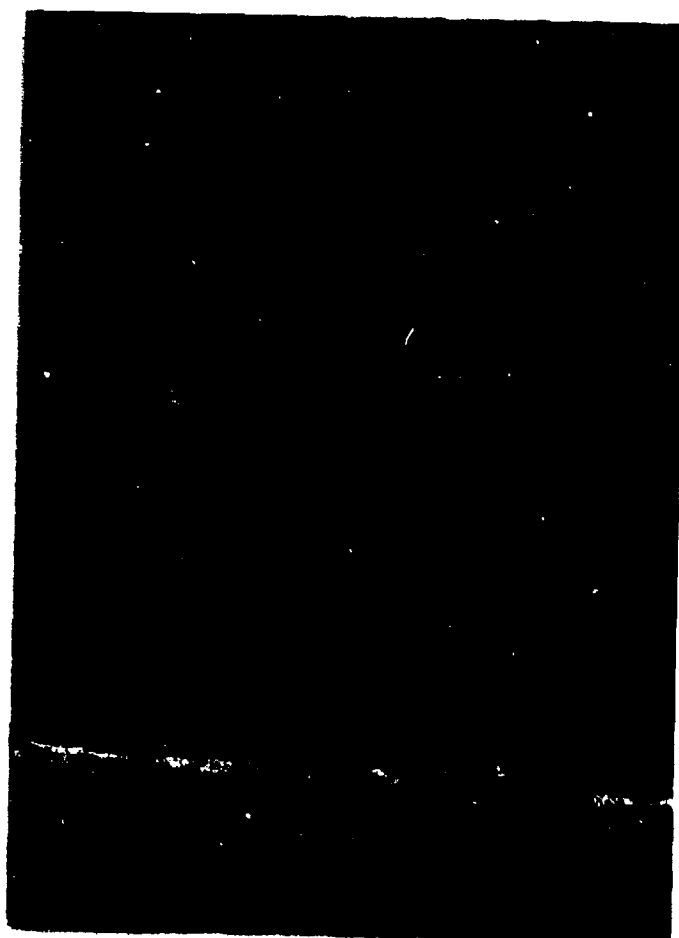
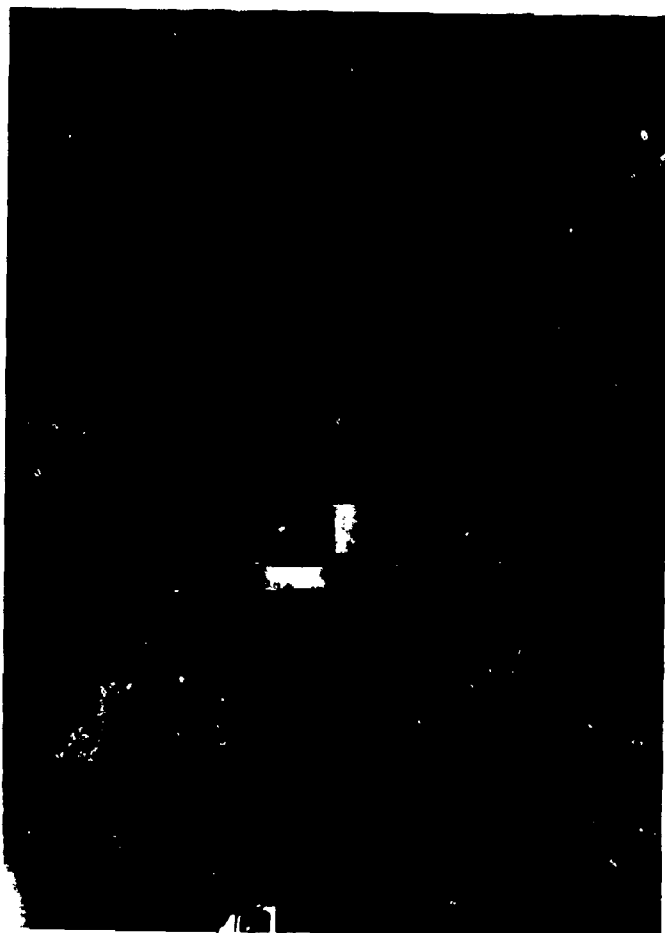
1. Upper left - View of crest and downstream slope of dam. View towards the left abutment.
2. Upper right - View of upstream slope of dam. Note gate house on upstream slope.
3. Lower left - View of spillway.
4. Lower right - View of spillway crest. View towards the right abutment. Note deterioration of concrete on right spillway wall.

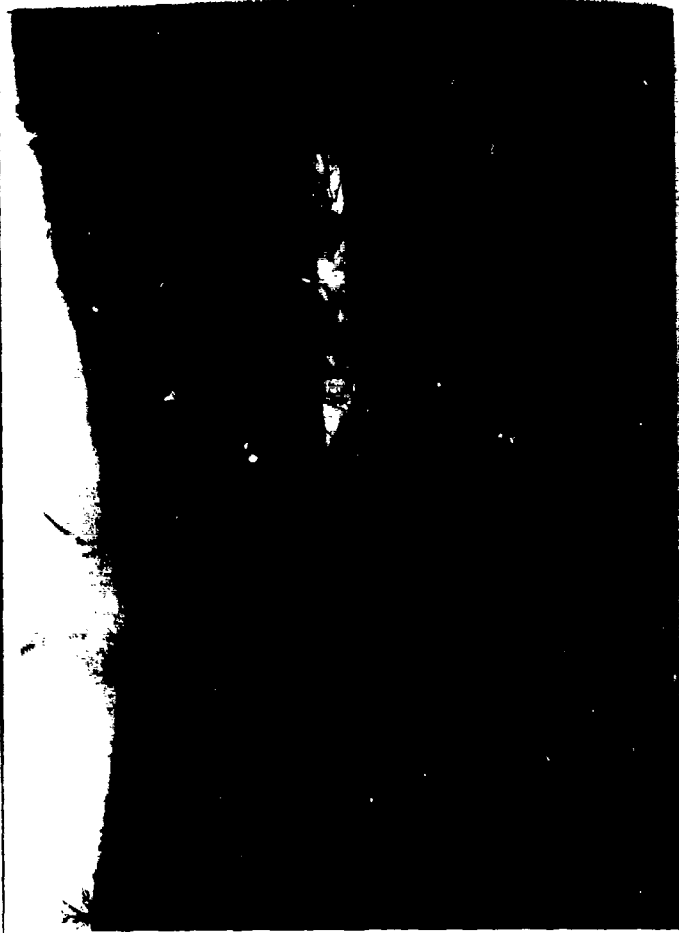
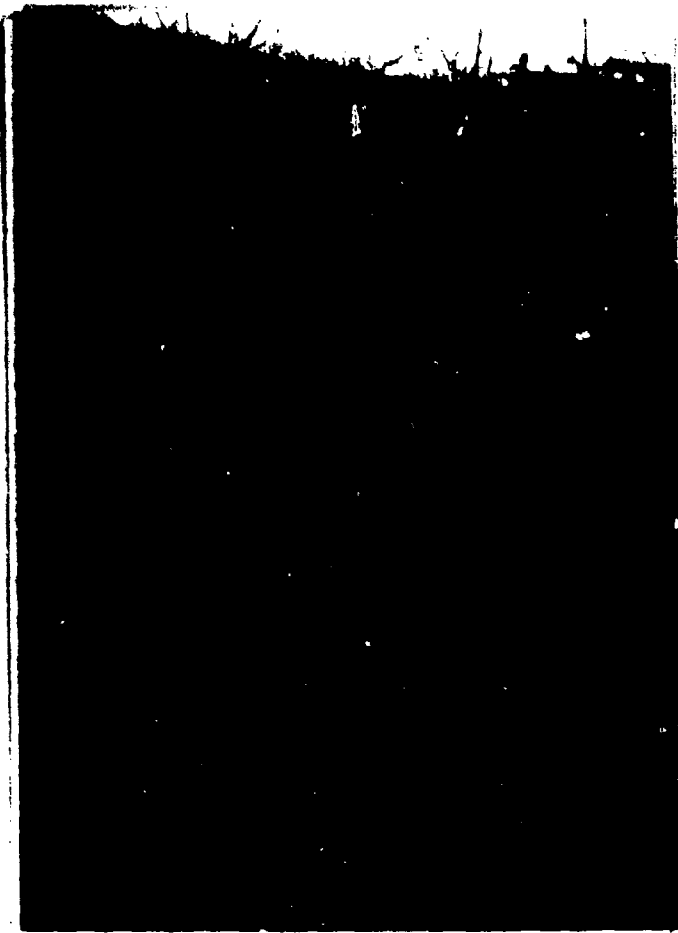
Sheet 1

Back

5. Upper left - View of downstream slope of dam. Note rock on slope.
6. Upper right - Downstream exposure.

1,5	2,6
3	4





APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall may be reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topographic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input, or sufficient dimensions input, and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF, the computer program will calculate the percentage of the PMF, which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS DATA BASE

NAME OF DAM: Bigby Run Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 24.0 inches

STATION	1	2	3
---------	---	---	---

Station Description	Bigby Run
---------------------	-----------

Drainage Area (square miles)	3.6
---------------------------------	-----

Cumulative Drainage Area (square miles)	3.6
--	-----

Adjustment of PMF for Drainage Area (%) ⁽¹⁾	(Zone 7)
6 hours	102
12 hours	120
24 hours	130
48 hours	140
72 hours	N/A

Snyder Hydrograph Parameters	
Zone ⁽²⁾	25
C _p ⁽³⁾	0.40
C _t ⁽³⁾	1.0
L (miles) ⁽⁴⁾	2.46
L _{ca} (miles) ⁽⁴⁾	1.14
t _p = C _t (L/L _{ca}) 0.3 hrs.	1.36

Spillway Data	
Crest Length (ft)	76
Freeboard (ft)	4.5
Discharge Coefficient	3.6
Exponent	1.5

- (1) Hydrometeorological Report 33 (Figure 1), U.S. Weather Bureau and U.S. Army Corps of Engineers, 1956.
- (2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).
- (3) Snyder's Coefficients.
- (4) L=Length of longest water course from outlet to basin divide.
L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.6 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 2130.0 [25 ac-ft]

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 2134.5 [43 ac-ft]

ELEVATION MAXIMUM DESIGN POOL: 2134.5

ELEVATION TOP DAM: 2134.5

SPILLWAY CREST:

- a. Elevation 2130.0
- b. Type Concrete ogee
- c. Width Crest length = 76 feet
- d. Length Not applicable
- e. Location Spillover Right abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type One 10" service and one 18" cast iron pipe drainline
- b. Location Mid embankment
- c. Entrance inverts Unknown
- d. Exit inverts 2109.2 [18" CIP]
- e. Emergency drawdown facilities 18" cast iron pipe

HYDROMETEOROLOGICAL GAUGES:

- a. Type None
- b. Location None
- c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

NOTE: Elevations referred to M.S.L.



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EDENSBURG PENNSYLVANIA

NAME BIGBY RUN DAM
NUMBER PA-226

SHEET NO. 1 OF 3
BY OTM DATE MAY, 1981

LOSS RATE AND BASE FLOW PARAMETERS

STRTL = 1 INCH
CNSTL = 0.05 IN/HR
STRTRQ = 1.5 CFS/MI²
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

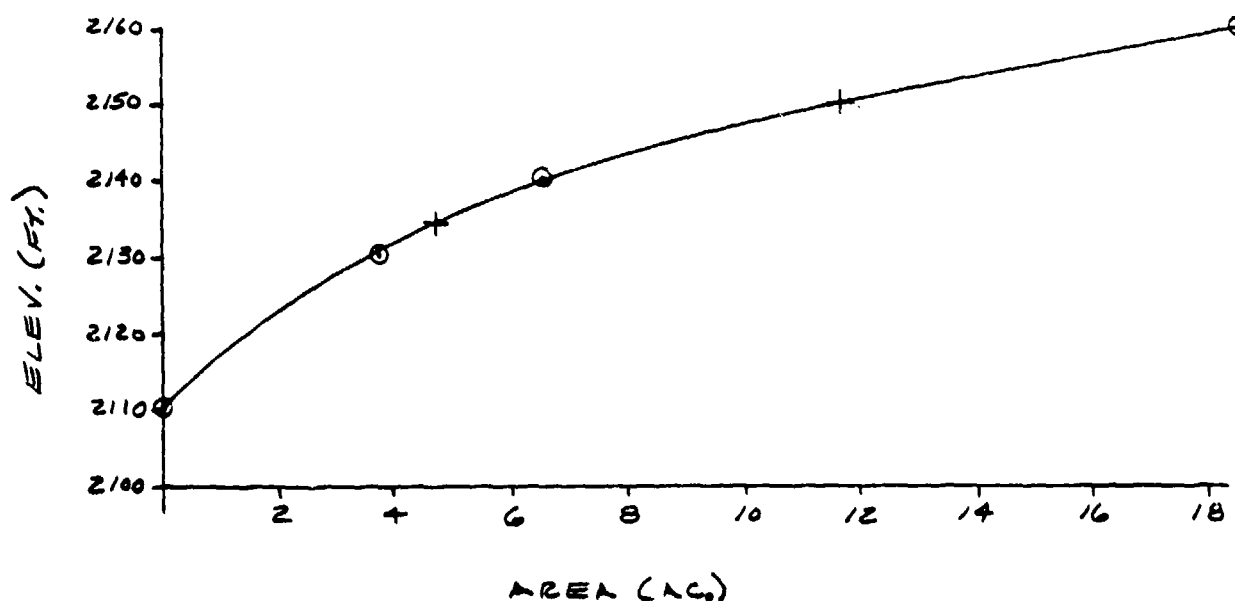
AS RECOMMENDED BY THE BALTIMORE DISTRICT
CORPS OF ENGINEERS.

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5-MIN. QUAD., D.E.R. FILES,
AND FIELD INSPECTION DATA.

SPILLWAY CREST ELEVATION = 2130.0
SURFACE AREA AT SPILLWAY CREST = 3.7 ACRES
ASSUME ZERO STORAGE AT ELEV. = 2110.0

AT ELEV. 2140, AREA = 6.4 ACRES
AT ELEV. 2160, AREA = 18.4 ACRES





L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME _____
NUMBER PA-226

SHEET NO. 2 OF 3
BY OTM DATE MAY, 1981

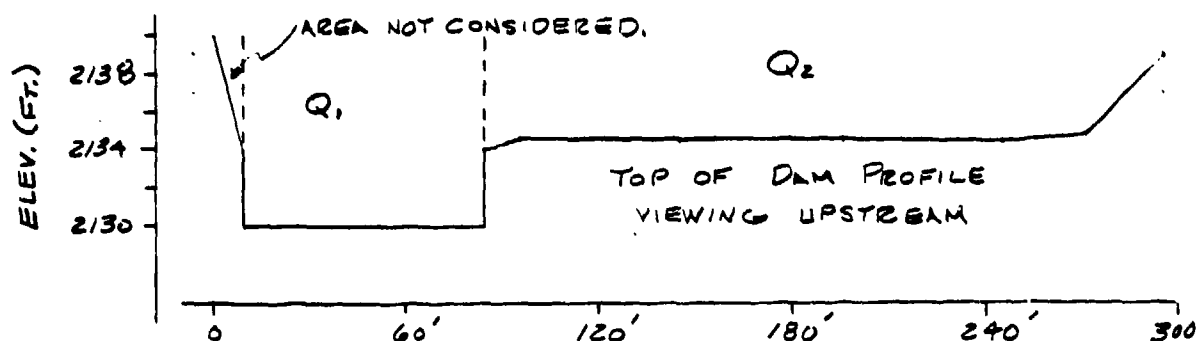
AREA (AC)	0	3.7	4.6	6.4	11.7	18.4
ELEV. (FT.)	2110	2130	2134.5	2140	2150	2160

DISCHARGE RATING

RATING CURVE INCLUDES POTENTIAL OVERTOPPING.

$$Q_1, \text{ SPILLWAY} = C_1 l_1 h_1^{3/2} \quad \text{USE } C_1 = 3.6, l_1 = 76' \quad h_{\text{MAX}} = 4.5'$$

$$Q_2, \text{ OVERTOP} = C_2 l_2 h_2^{3/2} \quad \text{USE } C_2 = 2.9, l_2 \text{ VARIES W/ } h_2$$



ELEV. (FT.)	SPILLWAY		OVERTOPPING			DISCHARGE Q (cfs)
	h_1 (FT.)	Q_1 (cfs)	h_2 (FT.)	l (FT.)	Q_2 (cfs)	
2130.0	0	0				0
2131.0	1	275				275
2132.0	2	775				775
2133.0	3	1420				1420
2134.0	4	2190				2190
2134.5	4.5	2610	—	—	0	2610
2135.0	5	3060	0.5	188	190	3250
2136.0	6	4021	1.5	194	1035	5060
2137.0	7	5070	2.5	200	2290	7360
2138.0	8	6190	3.5	206	3910	10100

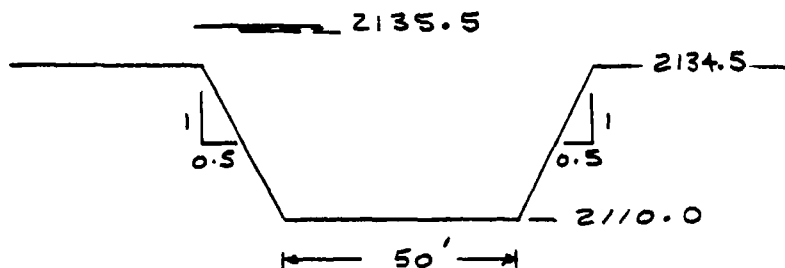


L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME _____
NUMBER PA-226

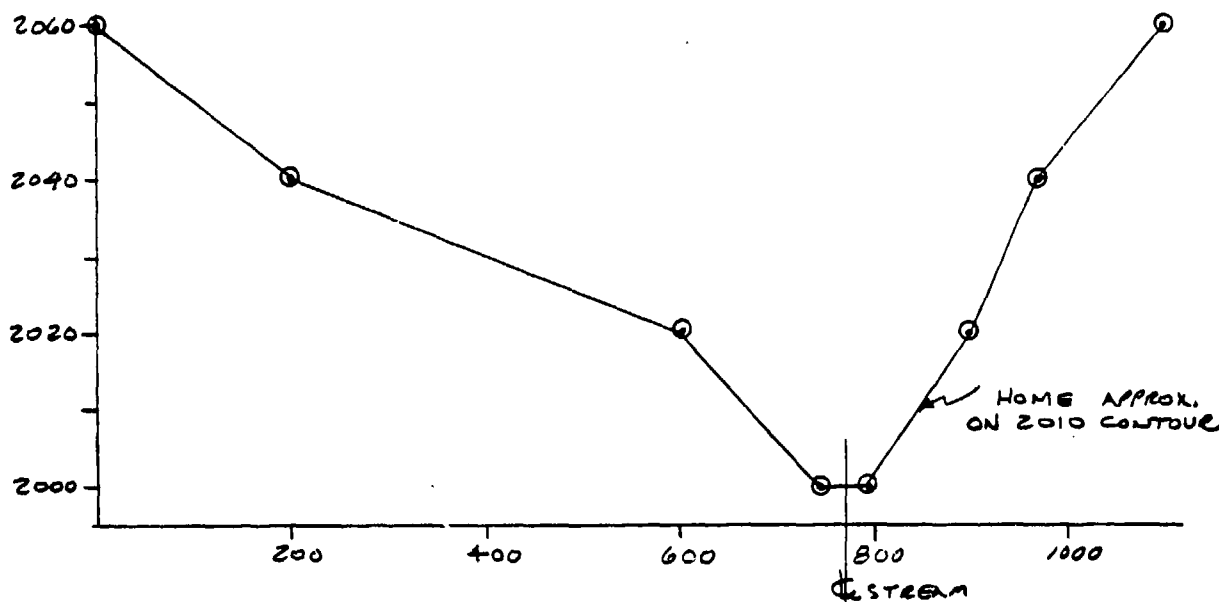
SHEET NO. 3 OF 3
BY OTA DATE MAY, 1981

DAM BREACH AND FLOOD ROUTING



BRWID = 50 FT.
Z = 0.5
ELBM = 2110.0
TFAIL = 3
WSEL = 2130.0
FAILEL = 2135.5

CONSIDER 1.0 FT. OF OVER-
TOPPING SUFFICIENT TO
CAUSE FAILURE OF THE
STRUCTURE.
DURATION OF OVERTOPPING
EQUALS 4.50 HRS.



REACH No. 1

REACH CROSS-SECTION LOCATED 1500 FT. DOWNSTREAM
OF DAM. SECTION FROM U.S.G.S. 7.5-MIN. QUAD.
MANNINGS CHANNEL (n) ASSUMED TO EQUAL 0.05
MANNINGS OVERTOPPING (n) ASSUMED TO EQUAL 0.06
AVERAGE SLOPE = 0.07

A1 ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
A2 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF BIGBY RUN DAM
A3 RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (PA-226)

D-8

 FLOC HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

RUN DATE= 01/05/19.
 TIME= 09.29.38.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF BIGBY RUN DAM
 RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (PA-226)

JOB SPECIFICATION									
NO	NHR	NMIN	IDAY	IMR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	-4	0
JOPER			5	LROPT		TRACE			
				NHT	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLAN= 1 NR10= 4 LR10= 1

RT10= 920 930 950 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRI	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INHYD	JUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.60	0.00	3.60	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	102.00	120.00	130.00	140.00	0.00	0.00

UNIT HYDROGRAPH DATA										
LOSS DAY					TP= 1.36					
LRPT	SIRK	DLTK	RTIOL	ERAIN	SINKS	RTIOK	STITL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

LIMIT HYDROGRAPH DATA

TP= 1.36 CP= .40 NTA= 0.

```

STRIP= -1.50
RECESSION DATA
QRCSEN= -.05
RTIOR= 2.00

```

UNIT	HYDROGRAPH	86	END-OF-PERIOD	ORDINATES,	LAG,	1.37	HOURS,	CP,	440	YOL	840	6570
25.	94.	192.	309.	434.	546.	631.	683.			689.		
615.	576.	539.	505.	473.	443.	415.	388.			364.		340.
319.	299.	280.	262.	245.	230.	215.	201.			188.		177.
158.	155.	145.	136.	127.	119.	111.	104.			98.		91.

NO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW	COMP Q	NO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
86.	44.	23.	12.	6.	75.	70.	66.	62.	58.	54.	51.	47.		
42.	22.	11.	6.	5.	39.	36.	34.	32.	30.	28.	26.	25.		
20.	10.	5.			20.	19.	18.	17.	16.	15.	14.	13.		
10.	5.				10.	10.	9.	9.	8.	8.	7.	7.		
5.					5.	5.	5.	4.						

SUM 33.60 31.12 2.48 409915.
(853.11 790.11 63.111607.50)

HYDROGRAPH ROUTING

ROUTE

ISTAG	ICOMP	TECOM	ITAPE	JPLT	JPRT	INAME	ISTAGE	TAUTO
2	1	0	0	0	0	1	0	0
ROUTING DATA								
QLOSS	CLOSS	AVG	IRES	ISAME	IORT	IPMP	LSTR	
0.0	0.000	0.00	1	1	0	0	0	
NSTPS NSTDL LAG ANSKK X TSK STORA ISPRAT								
1	0	0	0.000	0.000	-2130.	-1		
2131.00	2132.00	2133.00	2134.00	2134.50	2135.00	2136.00	2137.00	
2130.00	275.00	775.00	1420.00	2190.00	3250.00	5060.00	7360.00	

Q-11

STAGE 2130.00 2131.00 2132.00 2133.00 2134.00 2134.50 2135.00 2136.00 2137.00
 FLOW 0.00 275.00 775.00 1420.00 2190.00 3250.00 5060.00 7360.00
 SURFACE AREA= 0. 4. 5. 6. 12. 18.
 CAPACITY= 0. 25. 43. 73. 163. 312.
 ELEVATION= 2110. 2130. 2135. 2140. 2150. 2160.

CREL SPMID COQM EXPW ELEVEL COOL CAREA EXPL
 2130.0 0.0 0.0 0.0 0.0 0.0 0.0

TOPEL C M DATA EXPD DAMWID
2134.5 0.0 0.0 0.

PEAK OUTFLOW IS 2068. AT TIME 41.17 HOURS

PEAK OUTFLOW IS 3108. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 5168. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 10372. AT TIME 41.00 HOURS

6/10

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4
				.20	.30	.50	1.00

HYDROGRAPH AT	1	3.60 (9.32)	1	2075. (58.76)	3113. (89.13)	5188. (146.91)	10376. (293.82)
	2	3.60 (9.32)	1	2068. (58.55)	3108. (88.02)	5188. (146.90)	10372. (293.70)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF	
						MAX OUTFLOW HOURS	FAILURE HOURS
.20	2133.84	0.00	40.	2068.	0.00	41.17	0.00
.30	2134.89	.39	43.	3108.	2.17	41.00	0.00
.50	2136.06	1.56	51.	5188.	4.50	41.00	0.00
1.00	2138.19	3.60	62.	10372.	8.50	41.00	0.00

INITIAL VALUE
2130.00

SPILLWAY CREST
2130.00

TOP OF DAM
2134.50

ELEVATION
STORAGE
OUTFLOW

25.
0.

25.
0.

43.
2610.

 FLOC HYDROGRAPH PACKAGE (HEC-1)
 DAM FETV VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

A1 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
 A2 DOWNSTREAM CONDITION DUE TO OVERTOPPING OF BIGBY RUN DAM
 A3 PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH (PA-226)

0 0 0 0 0 0

0 10 0 0 0 0

1

IMFLOW

1 14 1

1.0 0.05

0.40 0.05 2.0

ROUTE

1 1 1

-2130 -1

2131 2132 2133 2134 2135 2136 2137 2138

2139 2140 2141 2142 2143 2144 2145 2146

2147 2148 2149 2150 2151 2152 2153 2154

2155 2156 2157 2158 2159 2160 2161 2162

2163 2164 2165 2166 2167 2168 2169 2170

2171 2172 2173 2174 2175 2176 2177 2178

2179 2180 2181 2182 2183 2184 2185 2186

2187 2188 2189 2190 2191 2192 2193 2194

2195 2196 2197 2198 2199 2200 2201 2202

2203 2204 2205 2206 2207 2208 2209 2210

2211 2212 2213 2214 2215 2216 2217 2218

2219 2220 2221 2222 2223 2224 2225 2226

2227 2228 2229 2230 2231 2232 2233 2234

2235 2236 2237 2238 2239 2240 2241 2242

2243 2244 2245 2246 2247 2248 2249 2250

2251 2252 2253 2254 2255 2256 2257 2258

2259 2260 2261 2262 2263 2264 2265 2266

2267 2268 2269 2270 2271 2272 2273 2274

2275 2276 2277 2278 2279 2280 2281 2282

2283 2284 2285 2286 2287 2288 2289 2290

2291 2292 2293 2294 2295 2296 2297 2298

2299 2300 2301 2302 2303 2304 2305 2306

2307 2308 2309 2310 2311 2312 2313 2314

2315 2316 2317 2318 2319 2320 2321 2322

2323 2324 2325 2326 2327 2328 2329 2330

2331 2332 2333 2334 2335 2336 2337 2338

2339 2340 2341 2342 2343 2344 2345 2346

2347 2348 2349 2350 2351 2352 2353 2354

2355 2356 2357 2358 2359 2360 2361 2362

2363 2364 2365 2366 2367 2368 2369 2370

2371 2372 2373 2374 2375 2376 2377 2378

2379 2380 2381 2382 2383 2384 2385 2386

2387 2388 2389 2390 2391 2392 2393 2394

2395 2396 2397 2398 2399 2400 2401 2402

2403 2404 2405 2406 2407 2408 2409 2410

2411 2412 2413 2414 2415 2416 2417 2418

2419 2420 2421 2422 2423 2424 2425 2426

2427 2428 2429 2430 2431 2432 2433 2434

2435 2436 2437 2438 2439 2440 2441 2442

2443 2444 2445 2446 2447 2448 2449 2450

2451 2452 2453 2454 2455 2456 2457 2458

2459 2460 2461 2462 2463 2464 2465 2466

2467 2468 2469 2470 2471 2472 2473 2474

2475 2476 2477 2478 2479 2480 2481 2482

2483 2484 2485 2486 2487 2488 2489 2490

2491 2492 2493 2494 2495 2496 2497 2498

2499 2500 2501 2502 2503 2504 2505 2506

2507 2508 2509 2510 2511 2512 2513 2514

2515 2516 2517 2518 2519 2520 2521 2522

2523 2524 2525 2526 2527 2528 2529 2530

2531 2532 2533 2534 2535 2536 2537 2538

2539 2540 2541 2542 2543 2544 2545 2546

2547 2548 2549 2550 2551 2552 2553 2554

2555 2556 2557 2558 2559 2560 2561 2562

2563 2564 2565 2566 2567 2568 2569 2570

2571 2572 2573 2574 2575 2576 2577 2578

2579 2580 2581 2582 2583 2584 2585 2586

2587 2588 2589 2590 2591 2592 2593 2594

2595 2596 2597 2598 2599 2600 2601 2602

2603 2604 2605 2606 2607 2608 2609 2610

2611 2612 2613 2614 2615 2616 2617 2618

2619 2620 2621 2622 2623 2624 2625 2626

2627 2628 2629 2630 2631 2632 2633 2634

2635 2636 2637 2638 2639 2640 2641 2642

2643 2644 2645 2646 2647 2648 2649 2650

2651 2652 2653 2654 2655 2656 2657 2658

2659 2660 2661 2662 2663 2664 2665 2666

2667 2668 2669 2670 2671 2672 2673 2674

2675 2676 2677 2678 2679 2680 2681 2682

2683 2684 2685 2686 2687 2688 2689 2690

2691 2692 2693 2694 2695 2696 2697 2698

2699 2700 2701 2702 2703 2704 2705 2706

2707 2708 2709 2710 2711 2712 2713 2714

2715 2716 2717 2718 2719 2720 2721 2722

2723 2724 2725 2726 2727 2728 2729 2730

2731 2732 2733 2734 2735 2736 2737 2738

2739 2740 2741 2742 2743 2744 2745 2746

2747 2748 2749 2750 2751 2752 2753 2754

2755 2756 2757 2758 2759 2760 2761 2762

2763 2764 2765 2766 2767 2768 2769 2770

2771 2772 2773 2774 2775 2776 2777 2778

2779 2780 2781 2782 2783 2784 2785 2786

2787 2788 2789 2790 2791 2792 2793 2794

2795 2796 2797 2798 2799 2800 2801 2802

2803 2804 2805 2806 2807 2808 2809 2810

2811 2812 2813 2814 2815 2816 2817 2818

2819 2820 2821 2822 2823 2824 2825 2826

2827 2828 2829 2830 2831 2832 2833 2834

2835 2836 2837 2838 2839 2840 2841 2842

2843 2844 2845 2846 2847 2848 2849 2850

2851 2852 2853 2854 2855 2856 2857 2858

2859 2860 2861 2862 2863 2864 2865 2866

2867 2868 2869 2870 2871 2872 2873 2874

2875 2876 2877 2878 2879 2880 2881 2882

2883 2884 2885 2886 2887 2888 2889 2890

2891 2892 2893 2894 2895 2896 2897 2898

2899 2900 2901 2902 2903 2904 2905 2906

2907 2908 2909 2910 2911 2912 2913 2914

2915 2916 2917 2918 2919 2920 2921 2922

2923 2924 2925 2926 2927 2928 2929 2930

2931 2932 2933 2934 2935 2936 2937 2938

2939 2940 2941 2942 2943 2944 2945 2946

2947 2948 2949 2950 2951 2952 2953 2954

2955 2956 2957 2958 2959 2960 2961 2962

2963 2964 2965 2966 2967 2968 2969 2970

2971 2972 2973 2974 2975 2976 2977 2978

2979 2980 2981 2982 2983 2984 2985 2986

2987 2988 2989 2990 2991 2992 2993 2994

2995 2996 2997 2998 2999 3000 3001 3002

3003 3004 3005 3006 3007 3008 3009 3010

3011 3012 3013 3014 3015 3016 3017 3018

3019 3020 3021 3022 3023 3024 3025 3026

3027 3028 3029 3030 3031 3032 3033 3034

3035 3036 3037 3038 3039 3040 3041 3042

3043 3044 3045 3046 3047 3048 3049 3050

3051 3052 3053 3054 3055 3056 3057 3058

3059 3060 3061 3062 3063 3064 3065 3066

3067 3068 3069 3070 3071 3072 3073 3074

3075 3076 3077 3078 3079 3080 3081 3082

3083 3084 3085 3086 3087 3088 3089 3090

3091 3092 3093 3094 3095 3096 3097 3098

3099 3100 3101 3102 3103 3104 3105 3106

3107 3108 3109 3110 3111 3112 3113 3114

3115 3116 3117 3118 3119 3120 3121 3122

3123 3124 3125 3126 3127 3128 3129 3130

3131 3132 3133 3134 3135 3136 3137 3138

3139 3140 3141 3142 3143 3144 3145 3146

3147 3148 3149 3150 3151 3152 3153 3154

3155 3156 3157 3158 3159 3160 3161 3162

3163 3164 3165 3166 3167 3168 3169 3170

3171 3172 3173 3174 3175 3176 3177 3178

3179 3180 3181 3182 3183 3184 3185 3186

3187 3188 3189 3190 3191 3192 3193 3194

3195 3196 3197 3198 3199 3200 3201 3202

3203 3204 3205 3206 3207 3208 3209 3210

3211 3212 3213 3214 3215 3216 3217 3218

3219 3220 3221 3222 3223 3224 3225 3226

3227 3228 3229 3230 3231 3232 3233 3234

3235 3236 3237 3238 3239 3240 3241 3242

3243 3244 3245 3246 3247 3248 3249 3250

3251 3252 3253 3254 3255 3256 3257 3258

3259 3260 3261 3262 3263 3264 3265 3266

3267 3268 3269 3270 3271 3272 3273 3274

3275 3276 3277 3278 3279 3280 3281 3282

3283 3284 3285 3286 3287 3288 3289 3290

3291 3292 3293 3294 3295 3296 3297 3298

3299 3300 3301 3302 3303 3304 3305 3306

3307 3308 3309 3310 3311 3312 3313 3314

3315 3316 3317 3318 3319 3320 3321 3322

3323 3324 3325 3326 3327 3328 3329 3330

3331 3332 3333 3334 3335 3336 3337 3338

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION STATION / AREA PLAN RATIO 1
 .50

HYDROGRAPH AT 1 3.00 1 5100.
 9.321 1 146.9111
 2 5100.
 1 146.9111

ROUTED TO 2 3.60 1 5246.
 9.321 1 148.5911
 2 5100.
 1 146.9011

ROUTED TO 3 3.60 1 5247.
 9.321 1 148.5911
 2 5105.
 1 146.8111

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

INITIAL VALUE SPILLWAY CREST TOP OF DAM
2130.00 2130.00 2134.50
25. 25. 43.
0. 0. 2610.

ELEVATION
STORAGE
OUTFLOW

RATIO OF PMF MAXIMUM RESERVOIR W.S.ELEV MAXIMUM DEPTH OVER DAM MAXIMUM STORAGE AC-FT MAXIMUM OUTFLOW CFS DURATION OVER TOP HOURS TIME OF MAX OUTFLOW HOURS TIME OF FAILURE HOURS
0.50 2135.06 1.34 50. 5257. 2.06 41.06 40.33

PLAN 2

INITIAL VALUE SPILLWAY CREST TOP OF DAM
2130.00 2130.00 2134.50
25. 25. 43.
0. 0. 2610.

ELEVATION
STORAGE
OUTFLOW

RATIO OF PMF MAXIMUM RESERVOIR W.S.ELEV MAXIMUM DEPTH OVER DAM MAXIMUM STORAGE AC-FT MAXIMUM OUTFLOW CFS DURATION OVER TOP HOURS TIME OF MAX OUTFLOW HOURS TIME OF FAILURE HOURS
0.50 2136.06 1.36 31. 5189. 4.80 41.00 0.00

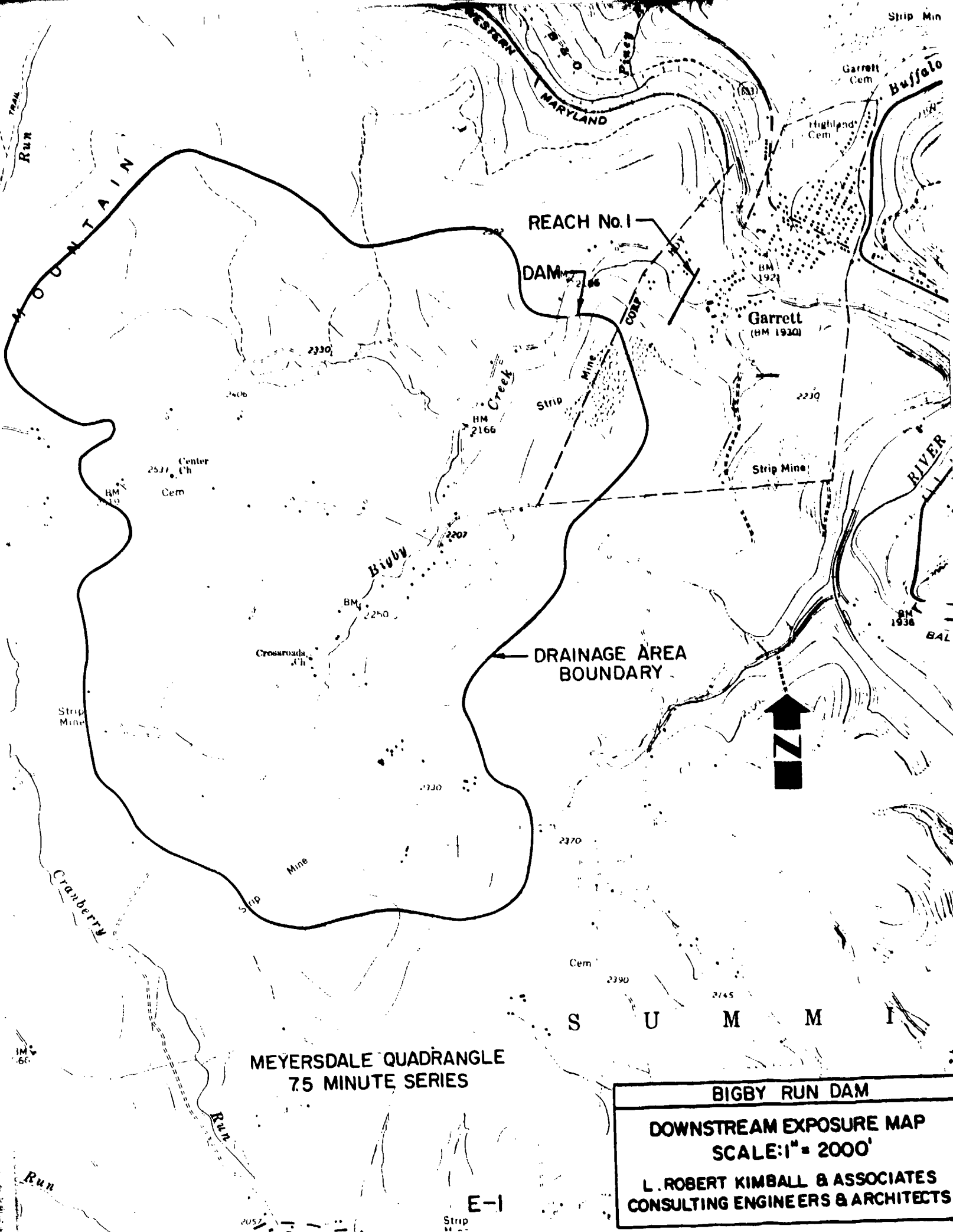
PLAN 1 STATION 2

RATIO MAXIMUM FLOW CFS MAXIMUM STAGE FT TIME HOURS
0.50 5247. 2003.9 41.17

PLAN 2 STATION 3

RATIO MAXIMUM FLOW CFS MAXIMUM STAGE FT TIME HOURS
0.50 5185. 2003.9 41.00

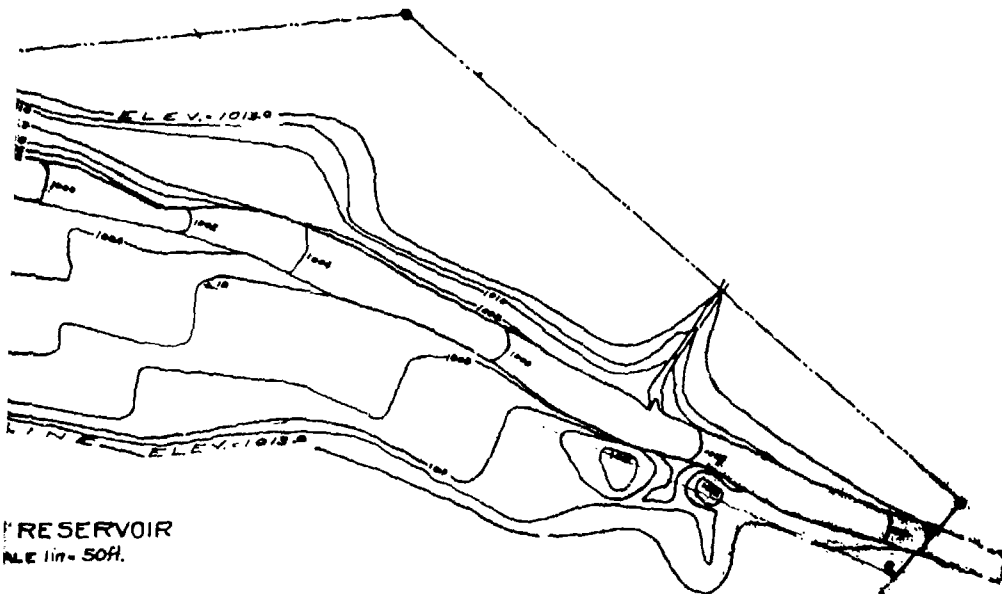
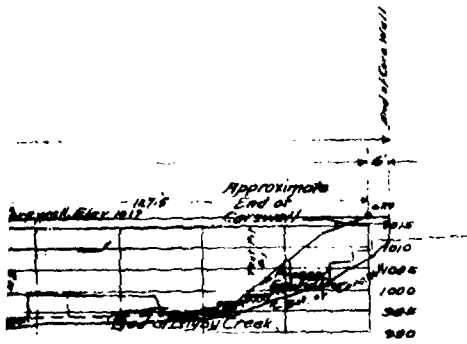
APPENDIX E
DRAWINGS



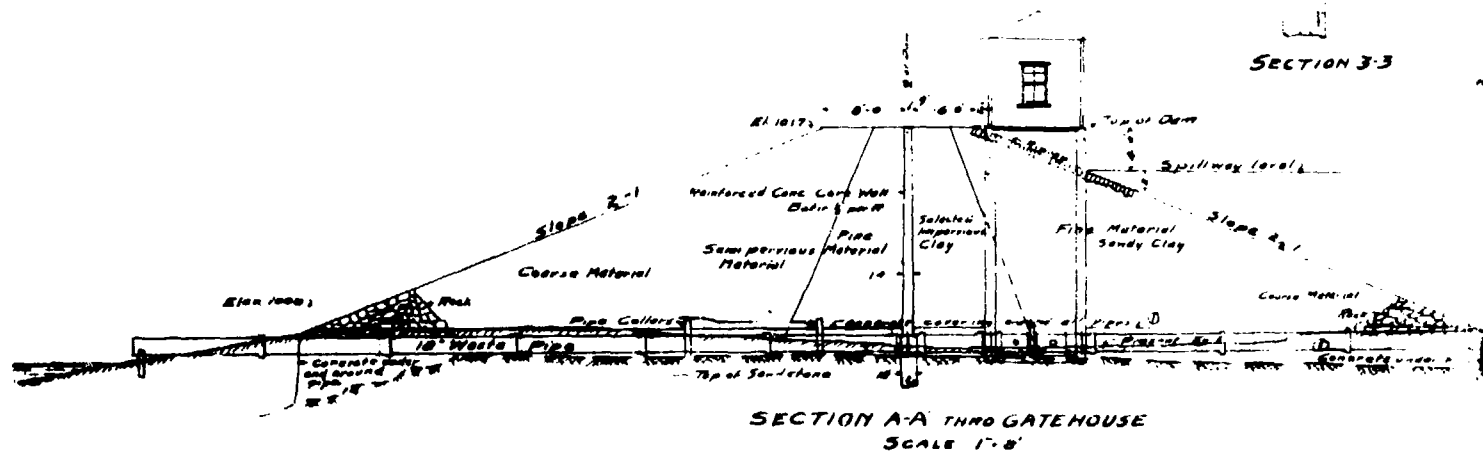
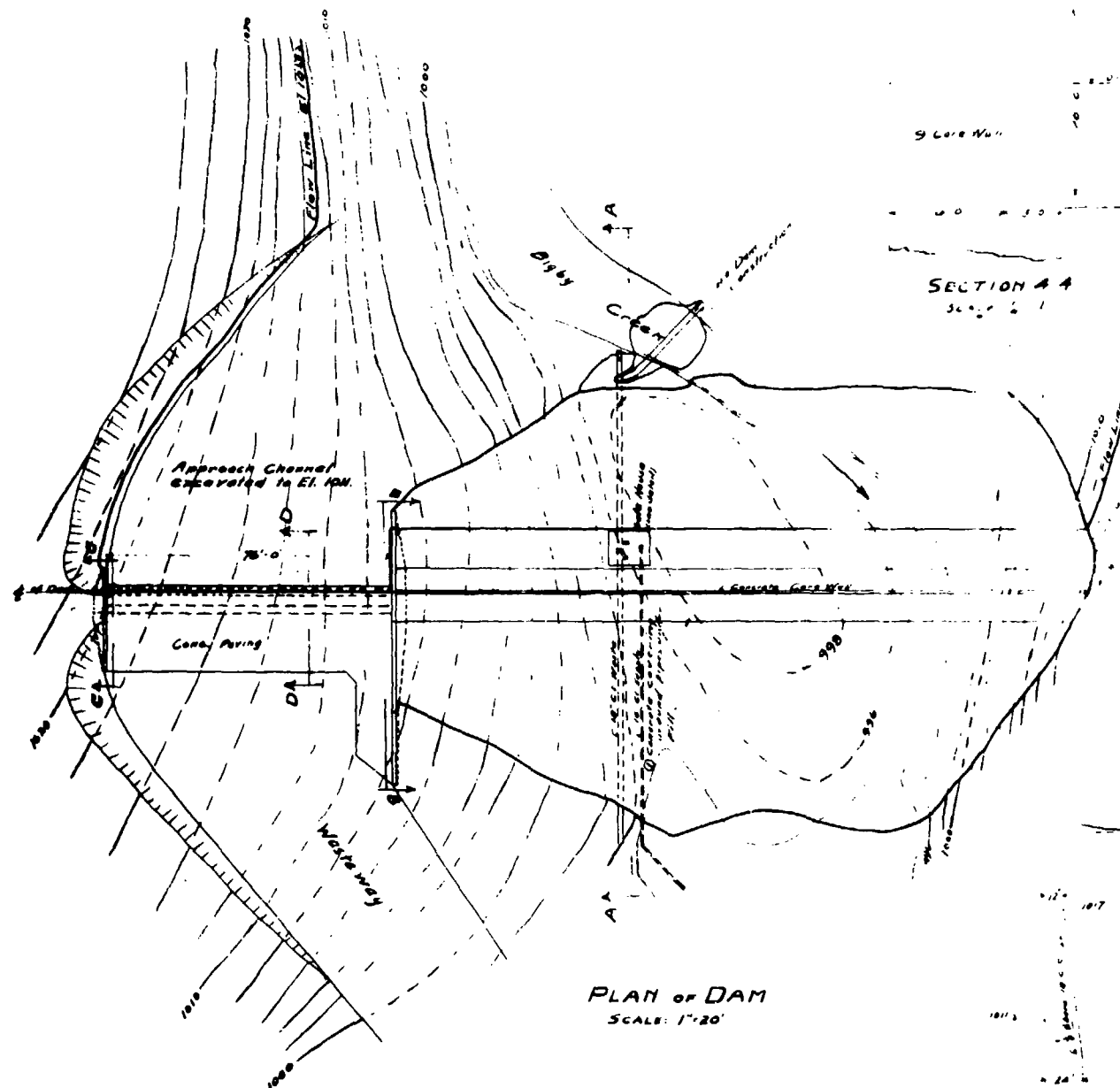
MEYERSDALE QUADRANGLE
75 MINUTE SERIES

E-1

BIGBY RUN DAM
DOWNSTREAM EXPOSURE MAP
SCALE: 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS



RESERVOIR
SCALE 1 in = 50 ft.



9 Core Wall

SECTION 4 4
SCALE 1"=10'

ELEVATION SECTION B-B
SCALE 1"=10'

ELEVATION C-C
SCALE 1"=10'

SECTION D-D THRU SPILLWAY
SCALE 1"=4'

TYPICAL SECTION OF WEIRWAY
Width varies from 76 to 41
SCALE 1"=10'

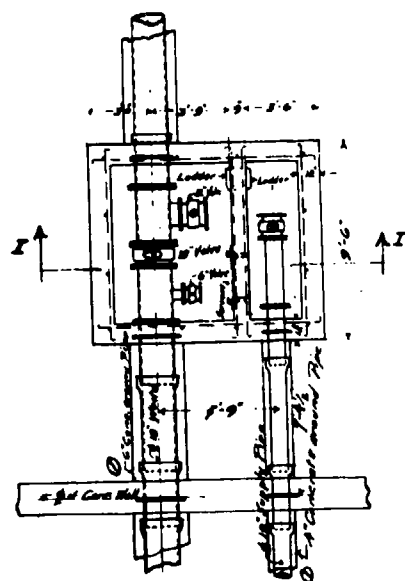
DIAGRAM OF SPILLWAY THROU

SECTION 3-3

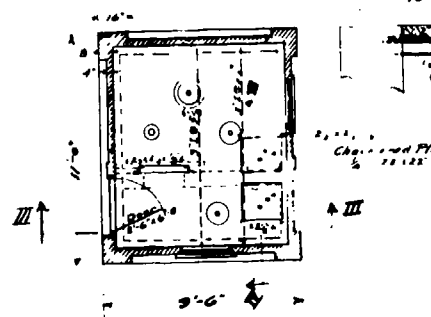
SECTION 1-1 OF RET. WALL
SCALE 1"=4'

SECT. 2-2 AT END OF WALL
SCALE 1"=4'

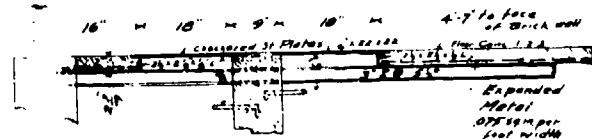
GARRETT WATER CO.			
DAM ON BIGBY CREEK			
SHEET - 1015-1016		DATE	
REVISION	DATE	BY	CHK
1	10/15/10	J. W. G.	J. W. G.
GRAY & CLARK		CONSULTING CIVIL ENGINEERS	
JANUARY 1911		JOB NO. 1015	



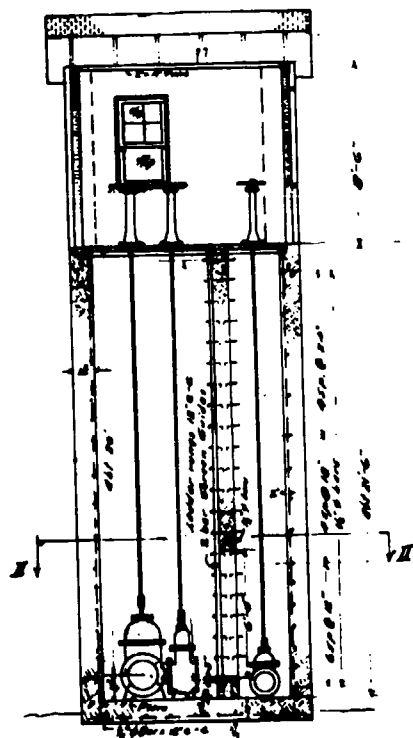
GATE HOUSE PIPING - SECT II-II



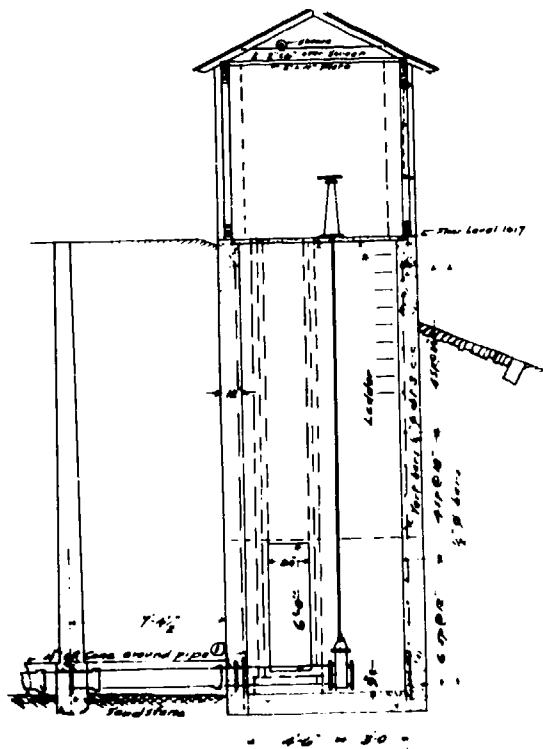
PLAN of GATE HOUSE FLOOR



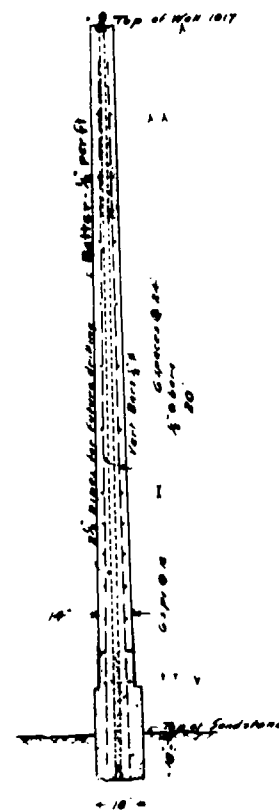
SECTION IV-IV
SCALE: $\frac{1}{8}$ " = 1'



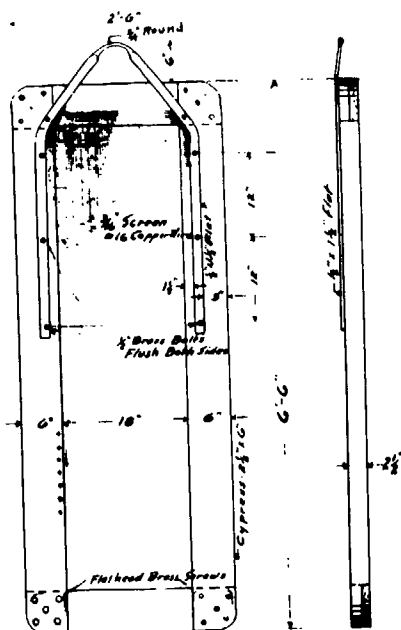
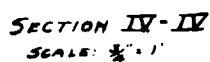
SECT. I-I THRO GATE HOUSE
SCALE: 1" = 4'



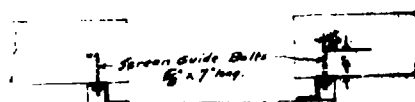
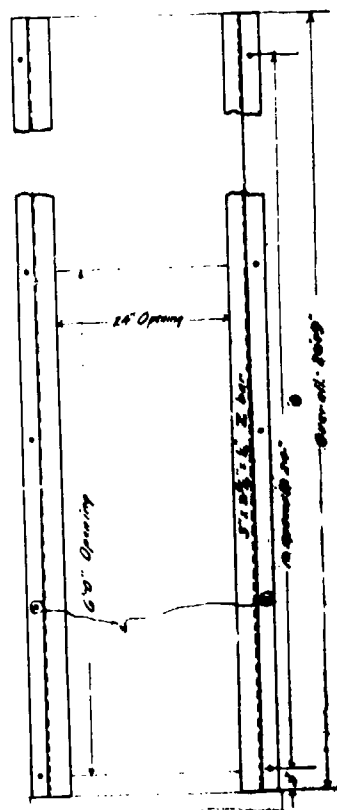
SECTION III-III
SCALE: 1" = 4'



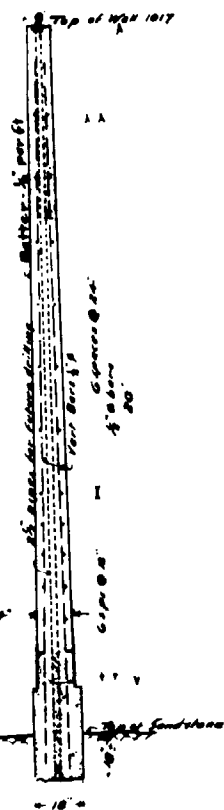
SECTION of CORE WALL
SCALE: $\frac{1}{8}$ " = 1'



DETAIL OF SCREEN
SCALE: 1"=1'

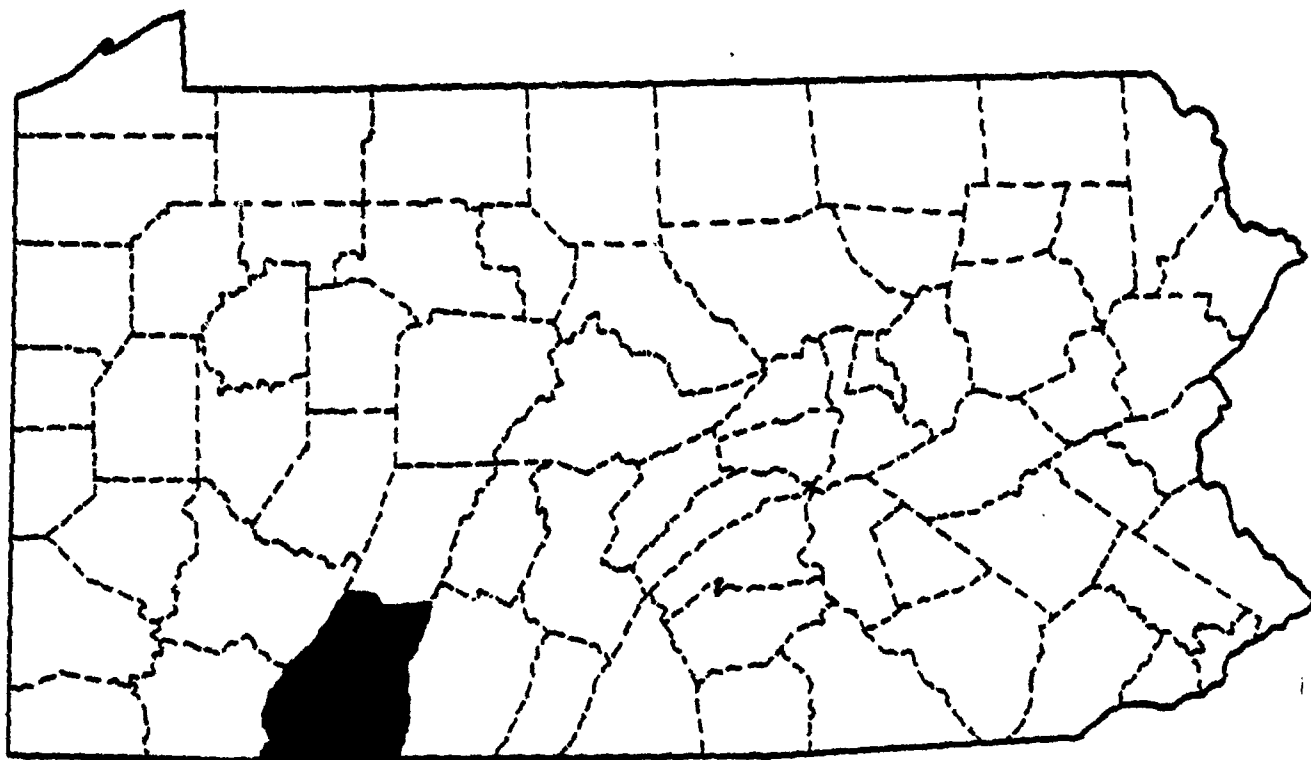


SCREEN GUIDES & BOLTS
SCALE: P-1



SECTION OF CORE WALL
SCALE: 1/4" = 1'

[illegible]



BIGBY RUN DAM

SITE LOCATION MAP
SOMERSET COUNTY, PENNSYLVANIA
E-5

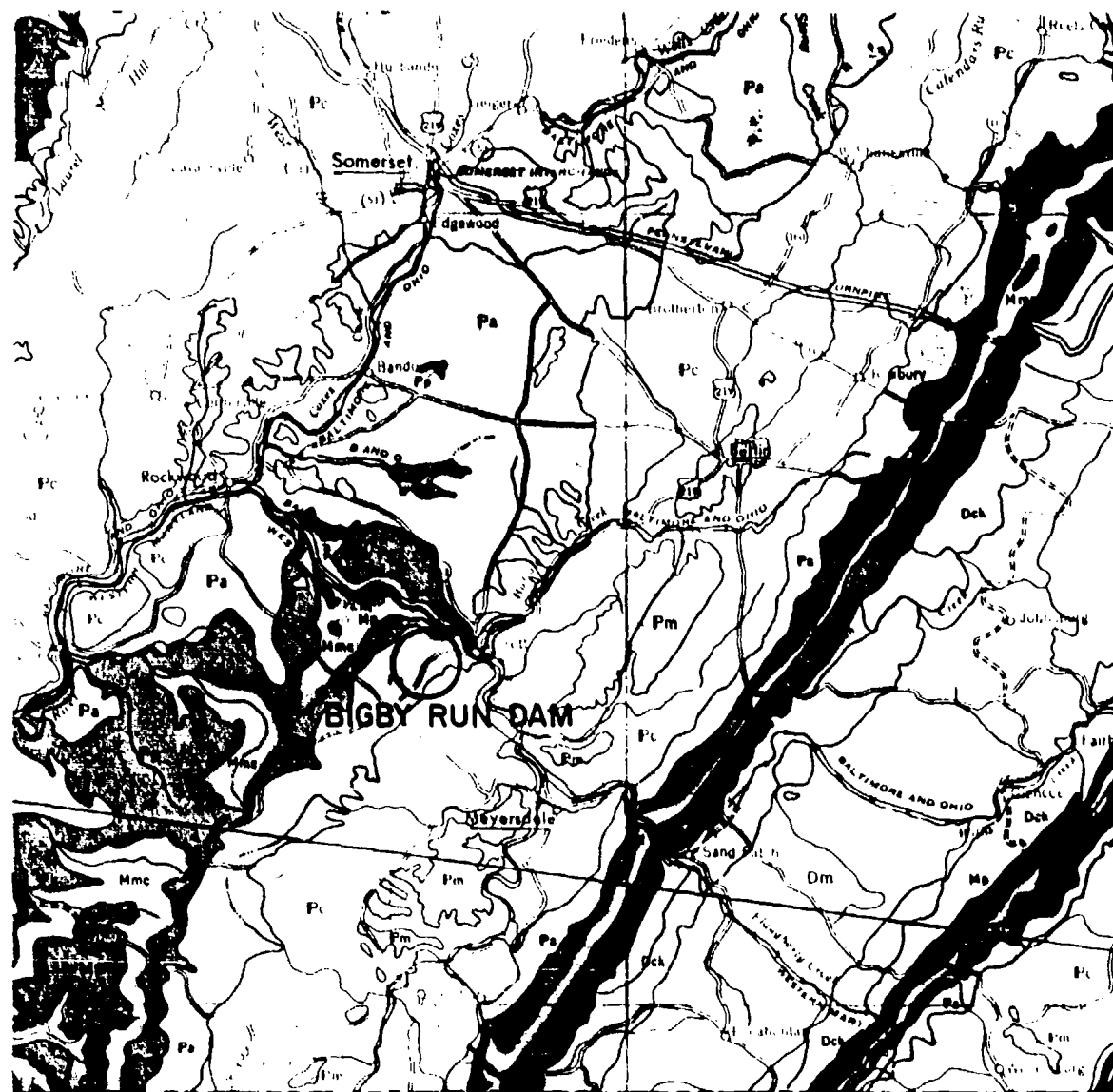
APPENDIX F
GEOLOGY

General Geology

The Bigby Run Dam is located in the Allegheny Mountain Section of the Appalachian Plateaus Province. This section lies between the Pittsburgh Plateaus Section to the west and Valley and Ridge Province to the east. It is typified by rather open folds with flank dips generally ranging between 5 and 20 degrees. The folding is more intense than the folding in the Pittsburgh Plateau Section, but is unlike the Valley and Ridge Province in that the valleys between the ridges stand relatively high and are underlain by rather gently inclined strata. Structurally, there is a parallelism of northeast-trending ridges. The Bigby Run Dam lies on the eastern limb of the Negro Mountain Anticline which is the common flank of the Berlin Syncline. The average strike of these folds and the subsequent strata is N32°E. The rock dips to the southeast about 5 degrees. No major faulting is noted in the vicinity of the dam.

The rock underlying the Bigby Run Dam and exposed in the nearby vicinity consists of shales, sandstones, and clays, with several workable coal beds. It belongs to the Kittanning Formation of the Allegheny Group of Pennsylvanian Age. This formation extends from the Upper Kittanning coal seam to the Lower Kittanning coal seam and has an average thickness of 100 feet. The bottom of the Allegheny Group is at the base of the Brookville-Clarion coal seam.

The dam is located in the Main Bituminous Coal Field, of which the Allegheny Group is characteristic due to the several workable coal seams it carries. In the area of the dam the Upper Kittanning coal seam has been eroded away. The dam rests on strata approximately 40 feet above the Lower Kittanning coal seam which is an economically important seam due to its consistent thickness and good quality. Its thickness ranges from 2.3' to 3.5'. Data obtained prior to 1974 indicates the Upper Kittanning seam has been mined to the southeast of the dam, and that no mining has occurred on the Lower Kittanning seam, beneath or near the Bigby Run Dam.



GEOLOGIC MAP OF THE AREA AROUND BIGBY RUN DAM
SCALE 1:250,000

PENNSYLVANIAN
APPALACHIAN PLATEAU

Pm

Monongahela Formation

Cyclic sequences of sandstone, shale, limestone and coal, limestone prominent in northern outcrop areas, shale and sandstone increase southward, commercial coals present near base at the bottom of the Potomac coal

Dch

Conemaugh Formation

Cyclic sequences of red and gray shales and siltstones with thin limestones and coals, massive Mahoning Sandstone commonly present at base, Ames Limestone present in middle of section, Brush Creek Limestone in lower part of section.

Pa

Allegheny Group

Cyclic sequences of sandstone, shale, limestone and coal, numerous commercial coals, limestone thicker westward, Vanport Limestone in lower part of section includes Freeport, Kittanning, and Clarion Formations



Pottsville Group

Predominantly sandstones and conglomerates with thin shales and coals, some coals minable locally